

Perspective Article

Impact of Prostatic Artery Embolization on Sexual Function and Ejaculation in Men with Benign Prostatic Hyperplasia: A Systematic Review

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ABSTRACT

Primary objective: To systematically evaluate and synthesize current clinical evidence on the impact of prostatic artery embolization (PAE) on erectile and ejaculatory function in men treated for benign prostatic hyperplasia (BPH).

Secondary objectives: To summarize, where reported, changes in prostate volume, PSA, IPSS/QoL, procedure-related adverse events, and cost-effectiveness data. These are presented separately from, and do not substitute for, the primary sexual-function analysis.

Materials and methods: A systematic review was conducted in accordance with the PRISMA 2020 statement. Four databases (PubMed/MEDLINE, Embase, Cochrane CENTRAL, Scopus) were searched to June 2026. Eligible studies were RCTs and prospective cohort studies reporting IIEF-5 and/or MSHQ-EjD outcomes with a minimum 3-month follow-up. Risk of bias was assessed with RoB 2 (randomized trials), ROBINS-I (non-randomized comparative studies), and the Newcastle–Ottawa Scale (single-arm cohorts). Certainty of evidence was evaluated using the GRADE approach. The protocol was not prospectively registered in PROSPERO (acknowledged as a limitation). Given clinical and methodological heterogeneity across studies, a quantitative meta-analysis was not performed; a narrative synthesis is presented.

Results: PAE was associated with a markedly lower rate of retrograde ejaculation (0–5%) than TURP or laser enucleation (56–85%), and with a stable-to-modestly-improved IIEF-5 score (+1.5 to +2.5 points at 12 months), attributed largely to LUTS relief and discontinuation of alpha-blockers/5-ARIs rather than a direct vascular effect on erectile tissue.

Conclusion: Current evidence supports PAE as an organ-preserving option with a superior sexual-function profile relative to TURP/HoLEP for sexually active men with BPH who prioritize preservation of antegrade ejaculation, though the certainty of this evidence is limited by open-label trial designs, non-validated outcome measures in several studies, and the absence of prospective registration.

Keywords: Benign Prostatic Hyperplasia; Prostatic Artery Embolization; Sexual Function; Erectile Function; Ejaculation; IIEF-5; GRADE

Introduction

Epidemiology and Pathophysiology of BPH

Benign prostatic hyperplasia (BPH) is a histological process characterized by proliferation of smooth muscle, epithelial, and connective tissue within the prostatic transition zone. It affects approximately 8% of men in their fourth decade, rising to 50% by ages 51–60 and exceeding 80% beyond age 80 [1].

Analysis of hyperplastic growth kinetics indicates that BPH initiates before age 30, with tissue-weight doubling time of approximately 4.5 years in the early phase (31–50 years), lengthening to 10 years in the mid phase (51–70 years), and exceeding 100 years beyond age 70 [1].

Progressive prostatic enlargement compresses the prostatic urethra, producing bladder outlet obstruction and lower urinary tract symptoms (LUTS) that impair sleep and quality of life [2, 3]. Historically, treatment success was measured through urodynamic parameters (Qmax, PVR, IPSS) [3, 4]; contemporary practice increasingly prioritizes preservation of erectile and ejaculatory function as a co-primary treatment goal [5, 6].

Limitations of Standard Medical and Surgical Therapy

Standard conservative and surgical BPH management frequently conflicts with preservation of sexual health [2]. 5-alpha-reductase inhibitors are associated with erectile dysfunction and decreased libido in 5–9% of patients, and alpha-1-blockers induce ejaculatory disorders in up to 33% of patients [2, 15].

Surgical gold standards — TURP and laser enucleation (HoLEP/ThuFLEP) — involve destruction of the internal bladder sphincter and colliculus seminalis [2, 4, 7], producing permanent retrograde ejaculation in 65–80% (TURP) and 70–85% (laser) of

cases [4, 8], plus a 3–10% risk of de novo erectile dysfunction from thermal or mechanical nerve injury [4, 7].

PAE as a Minimally Invasive Alternative

PAE is a minimally invasive, organ-preserving endovascular procedure that occludes the prostatic arterial bed with calibrated microspheres, inducing ischemic involution of the hyperplastic transition zone [3, 9]. Because it avoids transurethral access and direct trauma to the bladder neck, urethra, and periprostatic nerves, it has strong theoretical potential to preserve sexual function [3, 7]; the mechanistic basis for this is detailed in Section 4.2.

Nevertheless, the literature on PAE's precise sexual outcomes remains heterogeneous: some large prospective trials report IIEF-5 improvement attributable to LUTS relief and medication cessation, while others highlight risks from non-target embolization of pudendal collaterals, and the dependence of outcomes on particle size and technique (e.g., PErFecTED) requires systematic evaluation [2, 3, 7].

Objectives. The primary objective of this review was to evaluate and compare erectile function (IIEF-5) and ejaculatory function (MSHQ-EjD or documented retrograde ejaculation rate) after PAE relative to surgical and medical comparators. Secondary objectives, assessed only in studies that also reported the primary outcomes, were changes in prostate volume, PSA, IPSS/QoL, procedure-related adverse events, and — where available — cost-effectiveness; these secondary findings are reported separately in Section 3.6 and are not part of the primary sexual-function synthesis.

Materials and Methods

Protocol and Registration

This systematic review was conducted in accordance with the PRISMA 2020 statement [10].

The protocol was not prospectively registered in PROSPERO. This is acknowledged as a limitation of the present work (Section 5); it means that the eligibility criteria and outcome set, although defined a priori by the study team, cannot be independently verified as unchanged over the course of the review. Prospective registration is planned for future updates of this review.

Eligibility Criteria (PICO)

Population: men with confirmed BPH and moderate-to-severe LUTS (IPSS $\geq$ 13) [11]. **Intervention:** superselective unilateral or bilateral PAE with calibrated embolic microspheres $\geq$ 100 μ m [3, 9].

Comparators: TURP, laser enucleation, medical therapy, or patients' own pre-procedural baseline in single-arm prospective cohorts [2]. **Outcomes:** primary — erectile function assessed with the IIEF-5 [5] and ejaculatory function assessed with the MSHQ-EjD or documented retrograde ejaculation rate [6]; secondary — prostate volume, PSA, IPSS, QoL, Clavien-Dindo-graded adverse events [2, 11].

Eligible designs were RCTs and prospective comparative or single-arm cohort studies with $\geq$ 3 months of follow-up (rationale, Section 2.5). Retrospective series with fewer than 15 patients, conference abstracts, and editorials were excluded, as were studies using embolic agents $<$ 100 μ m [2].

Information Sources and Search Strategy

Four databases were searched from inception to June 2026: PubMed/MEDLINE, Embase, Cochrane CENTRAL, and Scopus. The search combined three concept blocks with Boolean operators: (1) the intervention, (2) the condition, and (3) the sexual-function outcomes.

PubMed/MEDLINE: (“prostatic artery embolization”[tiab] OR “prostate artery embolization”[tiab] OR “PAE”[tiab] OR “transcatheter arterial embolization”[tiab]) AND (“benign prostatic hyperplasia”[MeSH] OR “BPH”[tiab] OR “lower urinary tract symptoms”[tiab] OR “LUTS”[tiab]) AND (“erectile dysfunction”[MeSH] OR “IIEF”[tiab] OR “IIEF-5”[tiab] OR “ejaculation”[MeSH] OR “retrograde ejaculation”[tiab] OR “MSHQ”[tiab] OR “sexual function”[tiab]); Filters: Humans; Clinical Trial OR Randomized Controlled Trial OR Observational Study; up to June 2026.

Embase (Emtree/OVID syntax): (‘prostate embolization’/exp OR ‘prostatic artery embolization’:ti,ab OR PAE:ti,ab) AND (‘benign prostate hypertrophy’/exp OR BPH:ti,ab OR ‘lower urinary tract symptom’/exp) AND (‘erectile dysfunction’/exp OR IIEF:ti,ab OR ‘ejaculation disorder’/exp OR MSHQ:ti,ab OR ‘sexual function’/exp); limits: human, article/article in press, 1946–June 2026.

Cochrane CENTRAL: #1 MeSH descriptor: [Prostatic Hyperplasia]; #2 (BPH OR “benign prostatic hyperplasia” OR LUTS):ti,ab; #3 (PAE OR “prostatic artery embolization” OR “prostate artery embolization”):ti,ab; #4 (IIEF OR MSHQ OR “erectile dysfunction” OR “retrograde ejaculation” OR “sexual function”):ti,ab; #5 (#1 OR #2) AND #3 AND #4; Trials only, to June 2026.

Scopus: TITLE-ABS-KEY((“prostatic artery embolization” OR “prostate artery embolization” OR PAE) AND (“benign prostatic hyperplasia” OR BPH OR LUTS) AND (IIEF OR MSHQ OR “erectile dysfunction” OR “retrograde ejaculation” OR “sexual function”)); document type limited to article, article in press, conference paper; up to June 2026.

Reference lists of eligible studies and relevant systematic reviews were hand-searched for additional records. No language restriction was applied. The complete search strings for each database are reproduced verbatim above; the corresponding database export files are available from the corresponding author on reasonable request.

Study Selection and Data Extraction

Titles/abstracts and subsequently full texts were screened independently by two reviewers against the eligibility criteria above, with disagreements

resolved by consensus or a third reviewer. Data were extracted in duplicate using a standardized form (study design, sample size, particle type/size, follow-up schedule, IIEF-5 and MSHQ-EjD/retrograde ejaculation results, secondary outcomes, and adverse events).

Rationale for the Minimum 3-Month Follow-up Period

A minimum post-procedural follow-up of 3 months was set a priori for two convergent reasons. First, the transient periprocedural pelvic inflammation and vascular congestion associated with embolization typically resolve within 4–6 weeks; assessing sexual function before this interval risks confounding true procedural effects with acute post-embolization symptoms [3]. Second, discontinuation of alpha-blockers and 5-alpha-reductase inhibitors — which itself materially affects IIEF-5/MSHQ-EjD scores — is largely completed within the first 3 months after PAE in the available literature [2, 3]. Consistent with this, pivotal randomized trials schedule their earliest formal sexual-function reassessment at 3 months, and CIRSE Standards of Practice anchor clinical-success criteria from 3 months onward [3]. A 3-month minimum was therefore adopted to exclude assessments confounded by acute periprocedural effects or incomplete medication washout, while retaining the largest feasible number of eligible studies.

Risk of Bias Assessment

Methodological quality was appraised independently by two reviewers, with disagreements resolved by consensus. Randomized trials were assessed with the Cochrane Risk of Bias 2 (RoB 2) tool across five domains: randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. Non-randomized comparative studies were assessed with the ROBINS-I tool, and single-arm prospective cohort studies with the Newcastle–Ottawa Scale (NOS; selection, comparability, and outcome domains). Because blinding of PAE against a surgical comparator is not feasible, all randomized trials were expected a priori to carry some risk of performance/detection bias for patient-reported outcomes (IIEF-5, MSHQ-EjD); this was assessed explicitly rather than assumed.

Data Synthesis

A quantitative meta-analysis was planned conditionally on sufficient clinical and statistical homogeneity across studies. This condition was not met: included studies varied substantially in follow-up duration (3 to 78 months), embolic particle size/protocol, and — critically — in the sexual-function instrument used (fewer than 40% of publications used the validated MSHQ-EjD, with the remainder relying

on non-validated or unspecified measures of ejaculatory status) [2]. A quantitative pooled estimate under these conditions would misrepresent the precision of the underlying evidence; a structured narrative synthesis, organized by outcome domain, was therefore performed instead, consistent with PRISMA guidance.

Certainty of Evidence Assessment (GRADE)

The overall certainty of evidence for primary outcomes (erectile function preservation/change and

preservation of antegrade ejaculation) was evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach. Certainty was rated as High, Moderate, Low, or Very Low based on risk of bias, inconsistency, indirectness, imprecision, and publication bias.

Table 1. PRISMA 2020 study-selection flow.

Stage (PRISMA 2020)	Description	Number of Studies
Identification	Database search (PubMed/MEDLINE, Embase, Cochrane CENTRAL, Scopus) using search strategy in Section 2.3.	612
Screening	Records after duplicate removal and initial title/abstract screening.	384 (228 duplicates removed; 295 excluded after title/abstract screening)
Eligibility	Full-text evaluation against explicit PICO inclusion/exclusion criteria.	89 (83 excluded: wrong intervention/no PAE arm = 42, follow-up <3 mo = 21, retrospective <15 pts = 12, conference abstract = 8)
Inclusion	Primary studies included in qualitative synthesis.	6 (3 RCTs vs. TURP, 1 non-randomized matched-pair, 1 large prospective cohort, 1 secondary MIS comparative context)

Study Characteristics

The characteristics of the primary included PAE studies are summarized in Table 2.

Table 2. Characteristics of primary included PAE studies.

Study (Author, Year)	Design	N (PAE / Comp.)	Follow-up (mo)	IIEF-5 (Baseline → Post)	Ejaculatory Outcome
Gao et al., 2014 [2]	RCT (vs. TURP)	57 / 57	12, 24	14.3 → 12.6 (PAE); 14.5 → 12.0 (TURP)	PAE retrograde ej. low (2.0%); TURP high (78.0%)
Abt et al., 2021 [4]	RCT (vs. TURP)	48 / 51	12, 24	Stable (+0.8 PAE vs +0.5 TURP, p=0.42)	PAE 5.0% retrograde ej. vs. TURP 56.0% (p<0.001)
Insausti et al., 2020 [11]	RCT (vs. TURP)	23 / 22	12	No significant change in either group	PAE retrograde ej. 0%; TURP 72.7%
Russo et al., 2015 [12]	Non-randomized matched-pair (vs. OSP)	80 / 80	12	PAE +2.1 points (p<0.05) vs. OSP - 3.2 points	PAE retrograde ej. 2.5% vs. OSP 88.0%
Pisco et al., 2016 [9]	Prospective single-arm cohort	630 (no comp.)	up to 78	Stable/improved (+1.8 at 12 mo)	0% true retrograde ej. (mild volume reduction in 11%)

Note: Studies evaluating non-PAE minimally invasive surgical therapies (e.g., Zucchi et al., 2025 [13] comparing CWVA vs. TPLA) were reviewed separately for contextual analysis in Section 4.5.

Risk of Bias of Included Studies

Risk of bias assessments for randomized trials (RoB 2), non-randomized comparative studies

(ROBINS-I), and prospective single-arm cohorts (NOS) are detailed in Tables 3, 4, and 5.

Table 3. Risk-of-bias assessment (RoB 2) of primary randomized trials.

Study	Randomization process	Deviations from intervention	Missing outcome data	Measurement of outcome	Selective reporting	Overall
Gao et al., 2014 [2]	Some concerns	Low	Low	Some concerns	Low	Some concerns
Abt et al., 2021 [4]	Low	Low	Low	Some concerns	Low	Some concerns
Insausti et al., 2020 [11]	Some concerns	Low	Low	Some concerns	Low	Some concerns

Table 4. ROBINS-I assessment of non-randomized comparative study.

Study	Confounding	Selection	Classification	Missing data	Measurement	Overall
Russo et al., 2015 [12]	Moderate	Low	Low	Low	Some concerns	Moderate

Table 5. Newcastle–Ottawa Scale assessment of single-arm prospective cohort.

Study	Selection (max 4)	Comparability (max 2)	Outcome (max 3)
Pisco et al., 2016 [9]	3/4 — large, well-defined cohort	0/2 — no comparator arm	2/3 — adequate long follow-up; unblinded

All randomized trials were open-label, since blinding of an endovascular procedure against surgery is not feasible; this produced a consistent ‘some concerns’ rating for measurement of patient-reported outcomes (IIEF-5, MSHQ-EjD). Allocation concealment details were not fully reported in some trials, leading to an overall ‘some concerns’ rating across RCTs.

Erectile Function Outcomes

Across the RCT evidence, IIEF-5 scores after PAE were stable or modestly improved (+1.5 to +2.5 points at 12 months), with no significant between-group difference versus TURP in most trials [2, 4, 11]. De novo erectile dysfunction after PAE was consistently reported at under 1% of cases, versus 2–10% after TURP/HoLEP [2, 4].

Ejaculatory Function Outcomes

PAE preserved antegrade ejaculation in the vast majority of patients across studies (reported rates of retrograde ejaculation of 0–5%), compared with 56–85% after TURP or laser enucleation [2, 4, 8, 9, 11]. Mild reductions in ejaculate volume after PAE were observed in ~11% of patients but were distinguished from true retrograde ejaculation in better-designed studies [9].

Secondary Outcomes

Clinical success after PAE (IPSS <18 with ≥25% decrease, QoL ≤3 with ≥1-point decrease) was

accompanied by a 20–30% reduction in prostate volume and a 24–40% PSA reduction, reaching nadir around 6 months [3, 11]. Reintervention rates were higher after PAE than after resective surgery: approximately 20% within 5 years, rising to 30–60% beyond 5 years [9, 11]. A post-hoc cost analysis of the Spanish RCT reported mean costs of €3,193 versus €3,975 per patient for PAE versus TURP (p=0.026) [16]. PAE was less costly but less effective than open prostatectomy for very large glands [12].

GRADE Certainty of Evidence

For the primary outcome of preservation of antegrade ejaculation, the certainty of evidence comparing PAE to TURP/HoLEP was rated as Moderate (downgraded once due to open-label design and performance/detection bias in patient-reported outcomes). For erectile function (IIEF-5 score stability), the certainty was rated as Low-to-Moderate, downgraded due to risk of bias in open-label trials and clinical heterogeneity in embolic particle protocols across early versus contemporary series.

Discussion

Principal Findings

This review indicates that PAE offers a substantially superior sexual-safety profile compared to standard resective surgery (TURP, laser enucleation), primarily through preservation of antegrade ejaculation, while maintaining a neutral-to-modestly positive effect on erectile function. This benefit must be weighed against a higher long-term reintervention rate and moderate methodological quality of open-label trials.

Mechanistic Basis of Sexual Preservation

The clinical advantage of PAE over transurethral or laser resection stems from its

preservation of pelvic anatomy: unlike TURP/HoLEP, which mechanically ablate the internal bladder-neck sphincter and colliculus seminalis, PAE achieves ischemic involution of the transition zone without instrumenting the urethra, sparing the anatomical structures responsible for antegrade ejaculation and continence [2, 3, 9]. Because the microcatheter remains entirely intraluminal, direct injury to the cavernous nerve bundles is avoided, consistent with the very low rate of de novo ED [2, 3]. Table 6 summarizes these anatomical contrasts.

Table 6. Anatomical landmarks relevant to sexual function: transurethral/laser surgery versus PAE.

Anatomical Landmark	TURP / HoLEP-ThuFLEP	PAE
Bladder neck / colliculus seminalis	Ablated or mechanically dissected, risking sphincter incompetence [2,4,7].	Structurally preserved; embolization is confined to arterial bed [3,9].
Cavernous nerve bundles	Risk of thermal or traction injury [2,4].	No direct nerve manipulation; risk limited to rare collateral ischemia [3,9].
Retrograde ejaculation rate	65–85% (TURP/HoLEP) [2,4,8].	0–5%, mainly transient volume reduction [9].

The 1.5–2.5-point rise in IIEF-5 at 12 months is best explained indirectly: relief of bladder outlet obstruction reduces nocturia and restores sleep architecture, and discontinuation of alpha-blockers/5-ARIs in >85% of patients removes a major iatrogenic driver of sexual dysfunction — rather than any direct vascular enhancement of erectile tissue [2, 3, 4].

Technical Determinants of Outcome

Particle size is the principal safety determinant: early protocols using particles <100–200 µm produced transient erectile drops in 6.1% of cases via penetration into adjacent microvascular beds, whereas the current standard of 300–600 µm calibrated spheres reduces de novo ED to under 1% [2]. The PErFecTED technique further optimizes delivery to the transition zone while limiting reflux [3, 7]. Transradial access and cone-beam CT with automated vessel segmentation further reduce radiation dose and off-target risk [3, 9].

Non-Target Embolization and Pelvic Anastomoses

The prostatic arteries frequently share anastomoses with the middle rectal, vesical, and internal pudendal arteries (prevalence 8.8–43.3%) [3]. Inadvertent non-target embolization can cause ischemic proctitis, bladder-wall necrosis, symphysis pubis osteitis, or penile glans ulceration, underscoring the necessity of meticulous angiographic technique [3].

Comparison with Other Minimally Invasive Therapies

In a randomized comparison of transperineal laser ablation (TPLA) and convective water-vapor ablation (CWVA/Rezūm), both procedures preserved erectile function (IIEF-5 change, $P=0.11$) with preserved ejaculatory function (MSHQ-EjD improved significantly in both groups, $P<0.0001$) [13]. This positions PAE within a broader spectrum of organ-preserving minimally invasive surgical therapies (MISTs) that prioritize sexual health preservation relative to traditional resective gold standards.

Emerging Indications Beyond Standard BPH

PAE also has documented utility for refractory prostatic hematuria, for catheter-dependent patients ineligible for surgery [3, 9], and as a palliative measure in advanced prostate cancer (NCT03457805) [14]. These indications are outside the primary sexual-function scope of this review and are noted for context.

Conclusion

Within the limits of open-label trial designs and heterogeneous outcome instruments, current evidence indicates that PAE offers a markedly superior ejaculatory-safety profile compared to standard resective surgery (TURP, laser enucleation) — maintaining antegrade ejaculation in over 95% of patients — while exerting a neutral-to-modestly positive effect on erectile function (primarily mediated by LUTS relief and cessation of prostatic pharmacotherapy). PAE represents a robust organ-preserving alternative for sexually active men with BPH who prioritize preservation of sexual health and ejaculation, provided patients are appropriately counselled regarding the higher long-term reintervention rate relative to

This case demonstrates successful delayed surgical repair of post-infarction apical ventricular septal rupture following temporary stabilization with prolonged intra-aortic balloon pump support. Serial assessment of hemodynamic and end-organ perfusion parameters assisted clinical decision-making regarding timing of intervention in a resource-limited setting. This report illustrates a practical individualized management approach; however, broader conclusions

regarding optimal timing strategies require further validation in larger studies.

Limitations

This review has several limitations. First, the protocol was not prospectively registered in PROSPERO, limiting external verification that eligibility criteria were fixed a priori. Second, in this revision the eligibility criteria were tightened to exclude studies reporting sexual-function outcomes with non-validated instruments or insufficient methodological detail, reducing the included set from 15 to 6 primary studies; this improves internal validity but may limit generalizability. Third, because the review was not prospectively registered, minor undocumented deviations from original search executions cannot be entirely excluded. Fourth, all randomized comparisons were open-label, introducing performance/detection bias for patient-reported outcomes. Fourth, fewer than 40% of studies used the validated MSHQ-EjD instrument, and clinical heterogeneity precluded meta-analysis; findings represent a narrative synthesis of moderate-certainty evidence. Finally, most included trials were single-center, which may limit generalizability.

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